PATENT SPECIFICATION (11) 1 596 298

1 596 298

(21) Application No. 14783/77 (22) Filed 7 April 1977
(23) Complete Specification filed 4 April 1978
(44) Complete Specification published 26 Aug. 1981
(51) INT CL³ A61B 5/08
(52) Index at acceptance
G1N 19B1B 19B2F 19D12F0 19X5 1D3 1E 30P5 30PX 30R 4B 7N AEC

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(54) METHOD OF AND APPARATUS FOR DETECTING OR MEASURING CHANGES IN THE CROSS-SECTIONAL AREA OF A NON-MAGNETIC OBJECT

(71) We, P. K. MORGAN LIMITED, a British Company of 10 Manor Road, Chatham, Kent, ME4 6AL, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of and apparatus for detecting or monitoring changes in the cross-sectional area of a non-magnetic object, and has particular application to the detection of respiration in human and non-human animals. The invention was devised to detect and monitor respiration in humans, particularly critically ill patients in intensive care units.

Most methods used in the past involve the use of face masks or mouthpieces, which is not only invasive and discomforting to the patient, but also disturbs the very breathing patterns being measured. These prior art methods may require cooperation from the patient, impossible if the patient is critically ill or perhaps comatose, and mouthpieces may not be left in place for continuous monitoring. Other prior art methods which are less disturbing for the patient and his breathing pattern, such as use of the pneumograph, are incapable of providing data of sufficient accuracy for clinical use.

One prior art approach measured changes in the thickness of the chest by placing coils on the front and back, sending an alternating current through one coil, and detecting the voltage induced in the other coil. The equipment used was somewhat bulky, and the linear changes in chest thickness did not represent breathing volumes very well. It did have the advantage of not requiring face masks or mouthpieces, however.

According to one aspect of the invention there is provided a method of detecting changes in the cross-sectional area of a non-magnetic body, comprising looping an extensible electrical conductor in close encirclement around said body and detecting changes in the inductance of said conductor loop, whereby to measure changes in said cross-sectional area.

According to another aspect of the invention there is provided a method of measuring respiration in a body of a human or non-human, comprising looping two extensible electrical conductors in close encirclement around the body at different locations, obtaining electrical signals representative of the inductances of the respective conductors and thereby obtaining measures of the cross-sectional areas of the body at the respective locations, and calibrating the electrical signals such that their sum provides a measure of respiration of the animal.

According to a further aspect of the invention apparatus for detecting changes in the cross-sectional area of a non-magnetic object comprises a loop of flexible and elastically extensible material of a shape and size to encircle the body and conform to the shape of the body throughout changes in the cross-sectional area thereof, an electrical conductor which is attached to the loop in such manner as to encircle the body and which is shaped so as to be extensible with the material, whereby changes in said cross-sectional area effect changes in the inductance of the conductor, and detecting means operative to detect changes in the inductance of the conductor and thereby detect changes in the cross-sectional area of the non-magnetic body.

According to yet a further aspect of the invention there is provided apparatus for measuring respiration in a body of a human or non-human animal, comprising flexible and elastically extensible material for looping around the body so as to conform to the shape of the body during respiration,